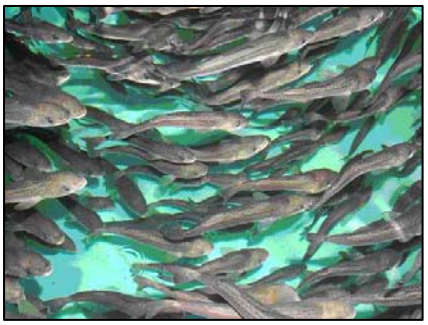
Briefing Materials

NOAA Aquaculture Program

NOAA Marine Fisheries Advisory Committee (MAFAC)

Ft. Lauderdale, Florida

February 14-16, 2006



www.aquaculture.noaa.gov

Intelligent Use of the Seas

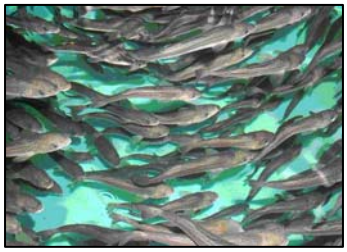
How NOAA's Aquaculture Investments Address our Nation's Growing Demand for Healthy, Safe Seafood

For over 125 years, the National Oceanic and Atmospheric Administration (NOAA) and its predecessor agencies have been leaders in the development of environmentally sustainable technologies to support marine aquaculture and the enhancement of living marine resources. As a result of this long-term investment by NOAA, marine aquaculture operations in the U.S. produce a consistent supply of safe seafood which complements the nation's wild fisheries harvest. U.S. farmed seafood also helps offset the nation's nearly $8 billion seafood trade deficit, provides thousands of jobs in U.S. coastal communities and an additional level of food safety and security for this nation.

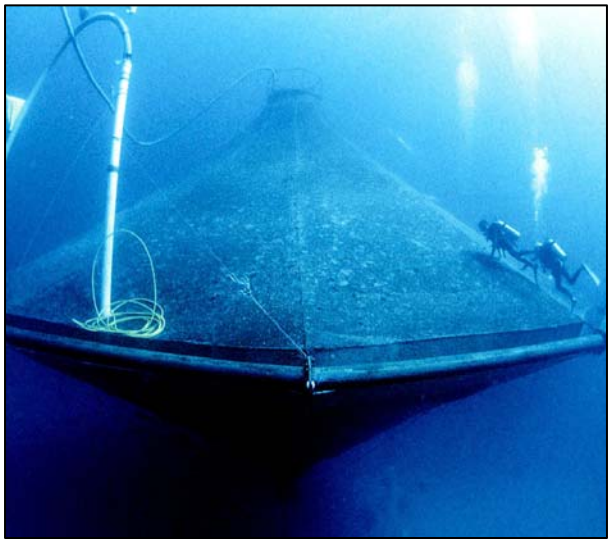
Right now, aquaculture is gaining momentum faster than any other form of food production worldwide, based on an unprecedented level of demand for seafood. For example, at current per capita consumption of one seafood meal a week – and with a modest increase in population – the U.S. will need another two million metric tons per year of seafood by 2025 to meet demand. The most obvious question is … where will more seafood come from? Even with production from wild capture fisheries at fully sustainable levels, increased aquaculture production from domestic or foreign sources will be required to increase the U.S. seafood supply. In the U.S., imports already make up 70% of the seafood we consume, and at least 40% of that imported seafood is farmed.

With the growing demand for seafood looming the Federal government, leading research institutions, the aquaculture industry and coastal communities are exploring options for increasing aquaculture production in the U.S. As the nation's oceans agency, NOAA is at the forefront of this exploratory effort. At the same time, NOAA's rich tradition of aquaculture research continues in the areas of marine stock enhancement, techniques and practices to protect the environment, social and economic impacts, feed formulation and the protection of aquatic animal health.

At this point, although aquaculture is widely recognized as a significant global industry for food production, the complex nature of the issues facing the emerging U.S. marine aquaculture industry continue to impede the development of domestic aquaculture to its full potential. Continued research and technology development is necessary to address production technology, health and nutrition and environmental and policy issues if the U.S. is going to attain the production goals stated in the 1999 Department of Commerce-NOAA Aquaculture Policy and to meet the policy recommendations made by the U.S. Commission on Ocean Policy in 2004.



Overview of the NOAA Aquaculture Program



As an agency under the U.S. Department of Commerce, the National Oceanic and Atmospheric Administration (NOAA) is focused on creating domestic seafood supply to meet the growing demand for all seafood products. Currently, over 70% of the seafood Americans consume is imported, and at least 40% of those imports are farmed seafood. Domestic aquaculture can be an effective option to reduce dependence on seafood imports, provide jobs for economically depressed coastal communities, and increase regional food supply and security.

For years, NOAA and its partners have worked with coastal communities interested in exploring shellfish and finfish aquaculture as another method to produce seafood, provide jobs and revenues, and use existing seafood processing facilities. As it develops, offshore aquaculture will be one component of the broad NOAA aquaculture program, which currently addresses coastal and onshore marine shellfish and finfish farming. NOAA's Aquaculture Program also includes stock enhancement research and hatchery activities which support commercial and recreational fishing, endangered species restoration and habitat restoration.

Status of the National Offshore Aquaculture Bill

On June 7, 2005, the Administration submitted to Congress for consideration and action *The National Offshore Aquaculture Act of 2005*. The bill would grant the Secretary of Commerce new authority to issue permits for offshore aquaculture in federal ocean waters, also known as the United States Exclusive Economic Zone, while providing environmental and other safeguards to protect wild stocks, marine ecosystems, and other users. The bill, which does not supersede existing authorities, specifically provides for coordination and consultation with other federal agencies, Fishery Management Councils, and coastal states. On June 8, 2005, the Administration's bill was introduced in the U.S. Senate by the Commerce Committee Co-Chairmen, Senator Ted Stevens and Senator Daniel K. Inouye, and is now known as S. 1195. For up-to-date information on the status of the bill, go to the Library of Congress website [http://thomas.loc.gov/], select "enter bill number" and type in "S1195".

U.S. Aquaculture and The National Offshore Aquaculture Act of 2005

Is Aquaculture Important?

Yes, demand for seafood is on the rise in the United States and abroad. Recent federal health guidelines call for Americans to double their seafood consumption. With capture fisheries stable or static, the increase in seafood supply will most likely come from aquaculture, imported or domestic. Currently, over 70% of the seafood that Americans consume is imported, and at least 40% is farmed seafood, grown primarily in Asia and South America. Domestic aquaculture can be an effective option to reduce dependence on seafood imports, provide jobs for economically depressed coastal communities, and increase regional food supply and security. There is also a continuing need to replenish and restore wild populations of marine shellfish and finfish in the United States through hatchery programs. Also called marine stock enhancement, this aspect of aquaculture is critically important to commercial and sport fishing and to endangered species and habitat restoration.

Aquaculture Technology Benefits the U.S. Economy

In the United States, freshwater aquaculture production, such as catfish, far outpaces marine aquaculture. And, despite all the attention on farmed fish, domestic marine production is dominated by shellfish aquaculture, including clams and oysters. In terms of benefits to the economy, the impact of NOAA-developed aquaculture technology amounts to at least $100 million annually and supports thousands of jobs in the United States. Innovation in offshore aquaculture here and abroad will advance technology and provide coastal communities with another method to produce seafood as a complement to wild capture fisheries. With aquaculture projected to provide more of the world's seafood supply, the United States also has an opportunity to lead by example and encourage producers in other countries to adopt best management practices developed here.

Rope cultured mussels grown in the Gulf of Maine

Need for Regulatory Framework Highlighted

Issued in December 2004, the *U.S. Ocean Action Plan* acknowledges the growing significance of domestic marine aquaculture for seafood production, and the need for a federal regulatory framework for marine aquaculture. The *Ocean Action Plan* addresses the recommendations of the U.S. Commission on Ocean Policy which, in its September 2004 report to Congress, calls on NOAA to develop a comprehensive, environmentally sound permitting and regulatory program for marine aquaculture. High-level attention to the issue is important since there is no clear mechanism for the permitting of marine aquaculture in federal waters. This regulatory uncertainty is widely acknowledged as the major barrier to the development of offshore aquaculture in the United States. To solve the problem, the Administration requested that NOAA develop legislation to establish a regulatory structure for offshore aquaculture in the United States. The legislation, *The National Offshore Aquaculture Act of 2005*, will facilitate marine aquaculture in federal waters where there is significant potential for development of the domestic aquaculture industry to meet the growing global demand for seafood. *The National Offshore Aquaculture Act* will call for environmental and other safeguards, including environmental requirements, monitoring and enforcement. Issue-specific concerns about offshore aquaculture will be addressed in the regulatory design process once Congress enacts the proposed legislation. The regulatory design process will include a strong role for states, fishery management councils, industry, conservation organizations and other interested stakeholders.

Can Offshore Aquaculture Work?

Yes, there are open ocean pilot projects for shellfish and finfish aquaculture in the United States right now, which are showing good production and environmental results. The projects, located in state waters in New Hampshire, Hawaii and Puerto Rico, demonstrate that the potential effects of open ocean facilities are minimized by proper siting.

The National Offshore Aquaculture Act At-A-Glance

Purpose: To provide the necessary authority to the Secretary of Commerce for the establishment and implementation of a regulatory system for aquaculture in Federal waters, also known as the U.S. Exclusive Economic Zone (EEZ).

What the Bill Would Do

1. Authorize the Secretary of Commerce to issue offshore aquaculture permits and to establish environmental requirements where existing requirements under current law are inadequate.
2. Exempt permitted offshore aquaculture from legal definitions of fishing that restrict size, season and harvest methods.
3. Authorize the establishment of a research and development program in support of offshore aquaculture.
4. Require the Secretary of Commerce to work with other Federal agencies to develop and implement a streamlined and coordinated permitting process for aquaculture in the EEZ.
5. Authorize to be appropriated "such sums as may be necessary" to carry out this Act
6. Provide for enforcement of the Act.

Major Features of the Proposed Regulatory Framework for Offshore Aquaculture

Permits

Aquaculture operations would require two permits: A site permit for a particular area of the EEZ and an operating permit for specific species and systems to be placed on the site.

- The Secretary of Commerce would be authorized to set fees and establish permit terms and conditions.
- Applicants would be able to submit applications for both permits for review at the same time.
- Permits would be transferable.
- Eligibility for permits would include foreign entities provided they have an agent in the U.S. and agree to be subject to U.S law.
- Once all permit requirements are met, the Secretary of Commerce would be required to render a decision within 120 days, or provide written notification to the applicant with an explanation and timeline for decision.

The Secretary of Commerce would be required to consult with federal agencies, Fishery Management Councils, states, and tribes before issuing a permit.

- Permit actions for sites located on leases or easements under the Outer Continental Shelf Lands Act (OCSLA), or within 1 mile of an OSCLA-permitted facility, would require concurrence from the Secretary of the Interior.
- The Secretary of the Interior would be authorized to impose additional requirements for aquaculture on OCSLA sites.

Most site permits would be for 10 years, renewable in 5-year increments.

- Permits for demonstration projects and for sites requiring Department of the Interior concurrence may differ.

Environmental Requirements

Permit decisions would be based on criteria that take into account environmental requirements and compatibility with other uses

- Environmental requirements would include those already in existence under current law, plus additional requirements that may be developed by the Secretary of Commerce in consultation with other federal agencies.
- Environmental requirements would address risks to and impacts on wild fish stocks, marine ecosystems, water quality, habitat, marine life, and other features of the environment.

Implementation of the Act would require compliance with the *Coastal Zone Management Act* and, to the extent practicable, the Secretary of Commerce would ensure that offshore aquaculture does not interfere with fisheries conservation and management.

The Secretary of Commerce would be authorized to collect information to evaluate the suitability of sites for aquaculture, to monitor the effects of aquaculture, and to take appropriate measures to ensure compliance with environmental requirements – including suspending, modifying, or revoking permits.

Permit holders would be required to post bonds or other financial guarantees, and would have to remove structures, gear, and other property and restore the site upon the expiration or termination of a permit.

Frequently Asked Questions
The National Offshore Aquaculture Act of 2005

Offshore Aquaculture

Q. I understand that the Administration has developed a National Offshore Aquaculture Act. What do you mean by "offshore"?
"Offshore" refers to the federally managed area of the ocean off the coasts of the United States and its territories. This begins where state jurisdiction ends (for most states, that's 3 nautical miles) and extends all the way out to the limit of the U.S. Exclusive Economic Zone (200 nautical miles in most places). The U.S. Exclusive Economic Zone covers an area equal to about 3.4 million square miles.

Q. What's the difference between offshore and other types of aquaculture?
Aquaculture is a broad term that covers a lot of territory and techniques. The basic distinction is freshwater vs. marine aquaculture. Today, the commercial U.S. aquaculture industry is dominated by freshwater species such as catfish and trout. The primary marine species are shellfish – including oysters, clams, and mussels. Other marine species include finfish, ornamental fish, and algae (aquatic plants, seaweed). What distinguishes offshore aquaculture from other forms of marine aquaculture is the location in open ocean waters that are exposed to wind and waves, not sheltered in bays or coves closer to shore.

Q. Why focus on the offshore?
The offshore area of the ocean has great potential for sustainable aquaculture of all kinds. It is a desirable location for two main reasons. First, there are fewer competing uses further from shore. Second, the deeper water and stronger water flows make it a more desirable location for environmental reasons.

Environmental Impacts/Standards

Q. Has NOAA considered potential environmental issues associated with this type of operation -- such as impacts of escapes, excess feed, fecal deposition, etc.? What will NOAA [the government] do to ensure offshore aquaculture operations do not pollute the environment?
Yes, NOAA has considered these and other types of environmental impacts, and is satisfied that the bill provides the necessary authority to require, through regulations or permit conditions, appropriate measures to avoid, minimize, or mitigate unacceptable impacts. As added insurance, the bill also provides authority to take emergency actions to address unanticipated impacts in a timely manner. Many types of impacts can be avoided or minimized through good siting and the use of best management practices, commonly known as BMPs, in the aquaculture operation. In terms of environmental impacts, NOAA and others have already done a lot of work to answer many of the environmental questions related to marine aquaculture, and more work will need to be done. NOAA has strong stewardship responsibilities, so the agency will implement this law in a way that does not jeopardize the conservation of marine resources.

Q. I have read/heard in recent news reports on the offshore bill that NOAA is ignoring the need for environmental standards for offshore aquaculture. Is that true?
That is not true. Despite claims to the contrary from the media and others, the establishment of rigorous environmental standards for offshore fish farming is central to the National Offshore Aquaculture Act. First though, the Department of Commerce [NOAA] must get authority from

Congress to establish these standards. Once Congress allows the Department of Commerce to regulate offshore aquaculture, NOAA will undertake an exhaustive public process to establish environmental standards before the first permit is issued. This regulatory design process will allow the American public a unique opportunity to influence these standards and to shape our seafood farming industry. This issue – and the issue of oil and gas platforms – are the two most frequently misrepresented aspects of the bill.

Q. Does the aquaculture bill include an opportunity for state consultation?
Yes, the bill calls for coordination with states as part of the permit process and consultations with states in establishing environmental requirements. Furthermore, it does not supersede any other laws, such as the Coastal Zone Management Act, that include a role for states with respect to activities in Federal offshore waters. Aquaculture facilities also will require support facilities on land, the construction and operation of which will be subject to state and local approvals. The bill specifically includes a provision on the need to consult with State agencies as part of the coordinated and streamlined permit process for offshore aquaculture, so States will have a say in decisions on offshore aquaculture permits as well.

Oil/Gas Platforms

Q. Isn't this legislation an effort to make it easier for oil companies to find a way to delay the removal of decommissioned oil and gas platforms?
No. In fact the legislation does not provide for the use of oil and gas platforms beyond the expiration of an Outer Continental Shelf Lands Act lease. The potential use of decommissioned platforms has been in the news lately because of current efforts on the part of states and private research facilities to study the feasibility of using decommissioned platforms as part of an infrastructure for offshore aquaculture. However, the use of these platforms comes with a difficult set of liability issues, which this legislation is not designed to address. This issue – and the issue of environmental standards – are the two most frequently misrepresented aspects of the bill.

The National Offshore Aquaculture Act of 2005

Q. Why isn't offshore aquaculture already underway in the United States?
A major barrier to the development of offshore aquaculture in the United States is regulatory uncertainty. It's just not possible to make rational business decisions unless you know what the rules are. And although certain laws already apply to an offshore aquaculture operation, they were all written before offshore aquaculture technology existed. They don't address all of the issues that need to be addressed in any comprehensive way and there is no clear mechanism for the permitting of marine aquaculture in Federal waters. That's why the Administration asked NOAA to develop legislation that would authorize the Department of Commerce to establish an overall regulatory structure for offshore aquaculture in the United States.

Q. What exactly will the legislation do?
The National Offshore Aquaculture Act will safeguard the environment and balance multiple uses of the oceans and coasts by providing for the establishment of environmental requirements and siting criteria, the monitoring of environmental impacts, and the enforcement of regulations and permit conditions. The Act will give the Department of Commerce authority to issue two types of permits for offshore aquaculture. A site permit, similar to a lease, will authorize a permit holder to use a specified area of the ocean for, in most cases, a period of 10 years,

renewable every five years. The site permit holder will also need an operating permit that will allow the placement of a particular facility and the growing of particular species on the site.

Q. Why is this legislation moving forward now?
Momentum and demand. NOAA has been working with industry and other interested stakeholders on iterations of this legislation for 10 years. In 2004, the need for this legislation was highlighted in the report of the U.S. Commission on Ocean Policy and in the Administration's response to the recommendations of the Commission. President Bush, in the U.S. Ocean Action Plan, made a commitment to transmit to the 109th Congress legislation to establish a regulatory structure for offshore aquaculture. With this legislation, that commitment has been met.

Implementation of the Act

Q. How does the legislation address such issues as environmental concerns, or state involvement?
Issue-specific concerns about offshore aquaculture will be addressed in the regulatory design process once Congress enacts the proposed legislation. The regulatory design process will include a strong role for states, fishery management councils, industry, conservation organizations and other interested stakeholders and will focus on specific issues of concern to these groups and others.

Q. How will the regulatory design process work?
There are formal rulemaking procedures that all Federal agencies follow in order to implement legislation that is enacted by the Congress and signed into law by the President. NOAA will undertake this type of rulemaking for the *National Offshore Aquaculture Act of 2005* once it is signed into law. In general, the process involves public notices, solicitation of public input, public meetings. Announcements are published in the Federal Register. The overall process should take about 2 years, including the development and publication of draft rules, a review period, and publication of final rules. During this time period, we will also undertake a programmatic Environmental Impact Statement in fulfillment of our responsibilities under the National Environmental Policy Act (NEPA). Although rulemaking cannot formally begin until the legislation is enacted, NOAA plans to begin working right away with our stakeholders to outline the many details that need to be addressed in rulemaking.

Permitting

Q. Will NOAA be acting alone in terms of issuing permits?
While NOAA will issue the aquaculture permits, the agency will not be acting alone. The bill specifically requires a public process of consultations with States, Federal agencies, tribes, and the public in offshore aquaculture permit decisions. Also, other Federal agencies will continue to issue permits under other laws, such as the U.S. Army Corps of Engineers for structures and the U.S. Environmental Protection Agency for water effluents. NOAA will coordinate the permit review process among other agencies and facilitate input from stakeholders.

Q. Will the permitted operations be subject to any other environmental laws?
Yes, definitely. The bill does not pre-empt or supersede any existing laws. So the offshore aquaculture operation will remain subject to the Clean Water Act, the Endangered Species Act, the Marine Mammal Protection Act, and all other applicable laws and regulations.

Q. Will an offshore aquaculture company be allowed to take fish from the wild to be raised in captivity?
This bill does not allow offshore aquaculture permit holders to take fish from the wild. If an offshore aquaculture company wanted to do so, they would have to comply with existing fishery management laws and regulations governing the taking of fish from the wild.

Q. How will the farmed fish be distinguished from wild fish in the marketplace?
At the retail level, fish already need to be labeled as farmed or wild under another law, the Country of Origin Labeling Act (COOL). The offshore aquaculture bill provides authority to require cultured fish or other marine species to be marked, tracked, or otherwise identified, using proven technology, record keeping, and enforcement methods. The specific requirements will be determined as part of the rulemaking process.

Aquaculture in Context

Q. Why is aquaculture a significant issue for the United States?
The top three reasons are – the growing global demand for seafood, our seafood trade deficit and the need for a safe, reliable seafood supply in this country.

Q. How much of the seafood we eat is imported?
Currently, over 70% of the seafood that Americans consume is imported.

Q. How much of our imported seafood comes from aquaculture?
At least 40% of our seafood imports are aquaculture products.

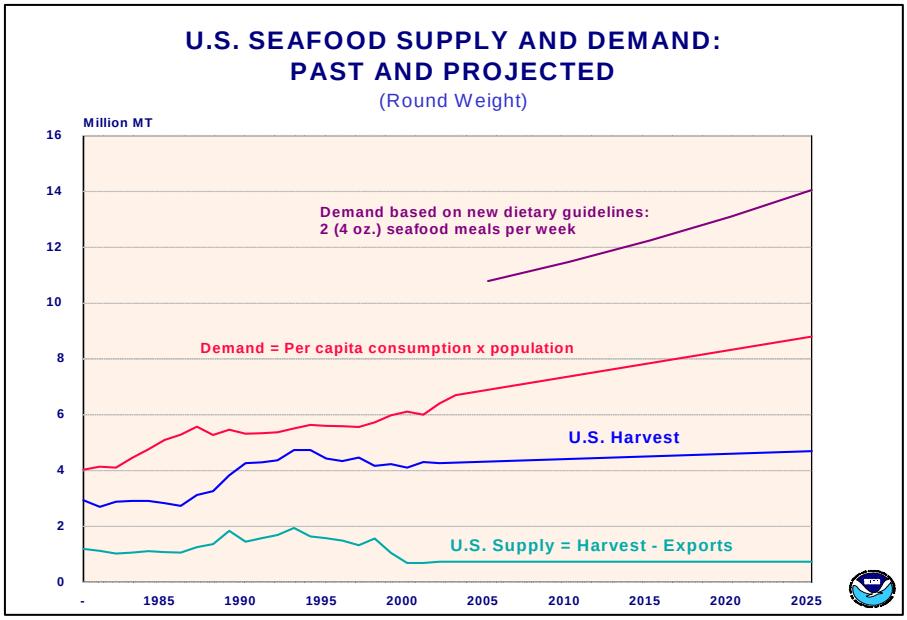
Q. What is the likely future demand for seafood in the United States?
Assuming current per capita consumption of about 16 pounds per person per year and current projections for increases in population, the United States will need an additional 2 million metric tons per year by 2025. If we are to more than double our seafood consumption as Federal nutritionists recommend, the United States will need an additional 4 to 6 million metric tons per year over current levels.

Q. Why is the Administration enabling development of offshore aquaculture? Why can't we just let foreign countries develop aquaculture?
We need a vibrant commercial aquaculture industry right here in the United States, because aquaculture can be an effective option to reduce our dependence on seafood imports, provide jobs for economically depressed coastal communities, and increase regional food supply and security. The reality of today's global seafood market is that seafood demand exceeds the supply from wild fisheries, and we are already getting a lot of our seafood from aquaculture – much of it imported. In the future, the gap between seafood demand and wild fisheries production will widen, and will only be filled through even greater aquaculture production. The only real question is whether that aquaculture production will come from U.S. production, or from imports.

Q. Why should the United States care about the seafood trade deficit?
The annual seafood trade deficit, which currently exceeds $8 billion, is a major contributor to the overall U.S. trade deficit. Besides the economic implications in terms of the overall balance of trade, there are food security implications related to our dependence on imported seafood.

Q. Why are the Department of Commerce and NOAA getting more involved in aquaculture?

Offshore aquaculture is something that the United States government cannot ignore. The Department of Commerce policy, which followed the NOAA policy, emphasizes the potential contribution of aquaculture to the economy. The NOAA policy focuses on specific actions to expand marine aquaculture in the United States through scientific, regulatory, outreach, and education initiatives. NOAA has the marine policy expertise, the stewardship successes, and the regulatory and research infrastructure to best facilitate and coordinate a regulatory program for offshore aquaculture in Federal waters.



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For more information on the bill, go to:

www.noaa.gov/aquaculture

For general information on marine aquaculture, go to:

www.aquaculture.noaa.gov

SECTION-BY-SECTION ANALYSIS

National Offshore Aquaculture Act of 2005

SUMMARY

The overall purpose of this Act is to provide the necessary authorities to the Secretary of Commerce for the establishment and implementation of a regulatory system for offshore aquaculture in the U.S. Exclusive Economic Zone (EEZ). Specifically, the Act:

- Authorizes the Secretary of Commerce to issue offshore aquaculture permits and to establish environmental requirements where existing requirements under current law are inadequate
- Exempts permitted offshore aquaculture from provisions of the Magnuson-Stevens Fishery Conservation and Management Act
- Authorizes the establishment of a research and development program in support of offshore aquaculture
- Requires the Secretary of Commerce to work with other federal agencies to develop and implement a streamlined and coordinated permitting process for aquaculture in the EEZ
- Authorizes to be appropriated "such sums as may be necessary" to carry out this Act
- Provides for enforcement of the Act.

While the Act provides the Secretary of Commerce with the authority to permit and oversee offshore aquaculture, it also preserves the existing authorities of other federal agencies, States, and Indian tribes and Alaska Native organizations, and requires concurrence from the Secretary of the Interior for aquaculture located on leases or easements authorized or for which a permit has been issued under the Outer Continental Shelf Lands Act (OCSLA), or within one mile of any facility for which a permit has been issued under the OCSLA.

Implementation of this Act will create an enabling environment for the offshore aquaculture industry in the United States in two ways:

- It provides for the establishment of an efficient regulatory process.
- It provides for a research program specifically dedicated to the development of environmentally responsible offshore aquaculture technologies.

SECTION 1. SHORT TITLE

Section 1 designates this Act as the "National Offshore Aquaculture Act of 2005."

SECTION 2. FINDINGS

Section 2 proclaims that it is the policy of the United States to support an offshore aquaculture industry compatible with other uses of the EEZ, encourage the development of responsible marine aquaculture in the EEZ, establish a permitting process for aquaculture in the EEZ, and promote research and development in marine aquaculture. This section also states that U.S. jurisdiction over offshore aquaculture is established under Presidential Proclamation 5030 of March 10, 1983, which declared that the U.S. EEZ extends 200 nautical miles from the coast.

The National Aquaculture Act of 1980 declared aquaculture development to be in the national interest, and included requirements for federal agencies to address barriers to such development. Both the Department of Commerce (in 1999) and, within the Department, the National Oceanic and Atmospheric Administration (NOAA) (in 1998) have endorsed aquaculture policies in support of the National Aquaculture Act, but additional statutory authority is needed in order to establish an enabling regulatory environment for aquaculture in the EEZ. This Act would provide the Secretary of Commerce with the necessary regulatory authority to establish and implement a permitting system, in consultation with other federal agencies, to create such an environment.

SECTION 3. DEFINITIONS

Section 3 defines key terms used in the Act. "Exclusive Economic Zone" is the area extending from the seaward boundary of State/Territorial jurisdiction out to 200 nautical miles from the baseline. The geographic extent of this area is identical to the Exclusive Economic Zone as defined under the Magnuson-Stevens Fishery Conservation and Management Act. "Offshore aquaculture" means all activities involved in the propagation and rearing (or attempted propagation and rearing) of marine species in the EEZ (i.e., beyond State or Territory jurisdiction). "Secretary" means the Secretary of Commerce.

Two types of permits for which the Secretary is given authority under this Act are defined. "Site permits" refer to a specified area of the EEZ that could be used for offshore aquaculture for a specified period of time, while "operating permits" refer to the specified marine species that would be permitted to be raised in a specific offshore aquaculture facility within the area described in the site permit.

Other terms defined include "demonstration", "Indian tribe and Alaska Native organization", "lessee", "marine species", "offshore aquaculture facility", "person", and "State." "Offshore aquaculture facility" includes areas of the seabed or subsoil used for growing sedentary species, in addition to installations and structures located in the water column or on the surface. "Marine species" excludes birds and mammals. "Person" includes non-U.S. individuals and corporations. "State" includes U.S. Territories and possessions.

SECTION 4. OFFSHORE AQUACULTURE PERMITS

Section 4 authorizes the Secretary of Commerce to establish a process to allow use of the EEZ for offshore aquaculture, gives the Secretary authority to issue site permits and operating permits, establishes criteria for issuing permits under this section, excludes offshore aquaculture from certain provisions of the Magnuson-Stevens Fishery Conservation and Management Act, grants the Secretary of Commerce authority to set fees and to modify or suspend permits issued under this section, and provides certain authorities to the Secretary of the Interior with respect to actions affecting the Outer Continental Shelf.

This section provides the basis for a new federal regulatory system for the offshore aquaculture industry. Many of the details of this system will be developed through rulemaking following enactment of this legislation. The rulemaking process, which will be conducted with stakeholder input, will provide a more appropriate forum for such fine-tuning adjustments than can be accommodated in legislation.

This section outlines the specific authorities granted to the Secretary of Commerce and to the Secretary of the Interior, and establishes specific requirements that must be met in implementing this new regulatory system. The language provides sufficient authority and flexibility to address the full range of anticipated issues through the rulemaking process, and also makes plain that permits issued under the Act do not supersede or substitute for any other required authorizations under other applicable federal or State law (e.g., NPDES permits under the Clean Water Act).

Section 4(a) - General

Section 4(a) contains provisions that apply to the overall permitting system authorized in the Act.

Overall process - In establishing a process for making areas of the EEZ available for development and operation of offshore aquaculture, the Secretary of Commerce is authorized to develop necessary procedures and to coordinate the permitting process and associated regulations with other federal agencies and States. The Secretary's authority includes the authority to establish how applications for permits will be made and to include special conditions on individual permits. The latter provision ensures the ability of the Secretary to address whatever future concerns are identified with particular aquaculture sites or operations.

Coordination with other federal agencies and States is an important element of the regulatory system established in this Act. Specific agencies are not listed so as to not inadvertently preclude coordination with an agency not listed, and to prevent having to amend this Act in response to future reorganizations or new or amended statutes governing other agencies. Multiple federal agencies have regulatory authority over aspects of offshore aquaculture operations in the EEZ. The U.S. Army Corps of Engineers has been the *de facto* lead permitting agency for offshore aquaculture permits, by virtue of its authority under the Rivers and Harbors Act of 1899 to require a section 10 permit certifying that an offshore aquaculture facility will not interfere with navigation. District Corps offices have coordinated interagency reviews of offshore aquaculture facility applications for section 10 permits and prepared environmental assessments for proposed facilities, with NOAA, EPA, and other federal agency participation in such reviews. The Act establishes specific offshore aquaculture permitting authority for the Department of Commerce and makes the Secretary of Commerce responsible for coordinating offshore aquaculture permitting activities. This will not preempt the authority of other federal agencies, such as EPA's authority under the Clean Water Act to require offshore aquaculture facilities that engage in the discharge of pollutants to obtain a permit, meet ocean discharge criteria, and comply with effluent guidelines.

For offshore aquaculture located on leases or easements authorized or for which permits have been issued under the Outer Continental Shelf Lands Act (OCSLA), or within one mile of facilities for which a permit has been issued under the OCSLA, the concurrence of the Secretary of the Interior is required. Offshore oil and gas platforms are being investigated as potential sites for offshore aquaculture facilities, so the Secretary of the Interior is also given specific authority with respect to offshore aquaculture located on such facilities.

Permits required - Section 4(a) makes it unlawful to engage in offshore aquaculture in the EEZ without two valid permits issued by the Secretary of Commerce: a site permit and an operating permit. The reason for two permits is to establish a general right to use an area of the EEZ for offshore aquaculture (site permit) and a more specific right to locate and operate specific types of aquaculture facilities to grow specific marine species on that site (operating permit). The site permit would establish where the permit holder may operate an offshore aquaculture facility, but the holder would not be allowed to install and operate the facility without an accompanying operating permit. The requirement for permits under this Act does not obviate the requirement for permits under other applicable authorities, such as the Clean Water Act.

Eligibility for permits - Section 4(a) establishes who is eligible to apply for offshore aquaculture permits. Eligibility extends to individuals who are residents of the United States (regardless of citizenship) as well as to corporations, partnerships, and other entities that are organized and exist under the laws of a State or the United States. This does not preclude applications by foreign companies or investors, provided they appoint and maintain agents within the United States who are authorized to receive and respond to any legal process issued in the United States, and, in some cases, waive immunity so as to be subject to U.S. jurisdiction.

Timely decisions - Section 4(a) provides for timely decisions on permit applications in two ways—first, by allowing concurrent submission and review of applications for site and operating permits, and second, by requiring the Secretary of Commerce to render a decision on each permit application within 120 days after determining that a permit application is complete and has satisfied all applicable statutory and regulatory requirements. These provisions are needed to ensure an efficient permitting process in which applicants receive decisions on proposed operations within a reasonable time frame. A prolonged application process is one of the chief criticisms of the current regulatory system for offshore aquaculture. The 120-day requirement will not jeopardize the ability of NOAA or other agencies to satisfy environmental and other review requirements, since the 120-day period would not begin until these requirements have been satisfied. In the event that the 120-day requirement cannot be met, the Secretary is required to provide written notice to the applicant indicating the reasons for the delay and a reasonable timeline for a permit decision.

Section 4(b) - Site Permits

Section 4(b) gives the Secretary of Commerce authority to issue site permits to eligible persons and requires the Secretary to specify the duration, size, and location of the marine aquaculture facility. The Secretary is given broad latitude to establish whatever specific terms and conditions are deemed necessary for any given site permit; however, the duration of the permit must be for a period of 10 years, renewable at the Secretary's discretion in 5-year increments. This provision is important to an offshore aquaculture business, which requires reasonable assurance of being able to occupy a particular site long enough to return a profit. It is also important to have a sufficiently long permit duration to satisfy financial institutions considering making loans to the aquaculture business. Many coastal States provide such security of tenure for aquaculture in State waters by offering leases.

Two exceptions to the 10-year site permit duration are demonstration projects, and offshore aquaculture located on leases or easements authorized or for which a permit has been issued by

the Department of the Interior under the Outer Continental Shelf Lands Act (OCSLA). In the latter case, the duration of the permit will be developed in consultation with the Secretary of the Interior. For aquaculture located on platforms or other facilities permitted under OCSLA, the permit cannot extend beyond the date on which an oil and gas lessee, or the lessee's operator, submits a final application to the Department of the Interior for removal of the facility upon which the offshore aquaculture facility is located. This is because the OCSLA requires removal of all facilities once production ceases, and it is not anticipated that the aquaculture industry would be interested in assuming liability for removing platforms, given the large costs associated with such an endeavor.

Upon termination of the site permit, the permit holders would be required to remove all structures, gear, and property from the site. The Secretary may also require the permit holder to take other measures to restore the site. For offshore aquaculture located on facilities authorized or for which a permit has been issued by the Department of the Interior under the OCSLA, the current and former OCSLA lessees, as well as the aquaculture permit holder, are liable for removal of any construction or modifications related to aquaculture operations if the aquaculture permit holder fails to do so and bonds posted for the aquaculture facility are insufficient to cover those obligations.

Section 4(c) - Operating Permits

Section 4(c) authorizes the Secretary of Commerce to issue operating permits to site permit holders. The specific design, construction, and operational details and other information to be provided in the permit application will be determined in the rulemaking process; however, the site permit holder must specify the marine species to be propagated and/or reared at the site. Failure to apply for an operating permit within a reasonable time could result in revocation of a site permit. This requirement is intended to prevent a speculation market for site permits, and to allow the Secretary to revoke the site permit of anyone who for whatever reason is not yet ready, willing, or able to pursue the necessary operating permit for the installation and start-up of an offshore aquaculture facility at the site.

Section 4(d) - Criteria for Issuing Permits

Section 4(d) requires that the Secretary ensure that aquaculture permitted under the previous sections meets environmental requirements established under other federal and State law and is compatible with other uses of the EEZ, specifically navigation, fishing, resource protection, recreation, national defense (including military readiness), and mineral exploration and development. This section also requires the Secretary to consider risks to and impacts on natural fish stocks, marine ecosystems, water quality, habitat, marine mammals, other forms of marine life, birds and endangered species, and other features of the environment, as identified by the Secretary in consultation with other federal agencies. It also requires compliance with applicable sections of the Coastal Zone Management Act, which requires federal actions to be consistent with approved State coastal management programs, and includes a provision for coordination of any additional consistency certifications required when offshore aquaculture takes place on facilities for which permits have been issued under the OCSLA. The Secretary is required to periodically review and modify the criteria for site and operating permits, as appropriate. This must be done in consultation with other federal agencies and must be based on the best available science.

The intent of these provisions is to provide a degree of predictability as to the types of aquaculture that are more likely to be approved for the EEZ and to provide a way for the concerns of other federal agencies and States to be considered in the decision process.

Section 4(e) - Exclusion from Provisions of Magnuson-Stevens Fishery Conservation and Management Act

Section 4(e) specifically excludes aquaculture conducted in the EEZ from the definition of "fishing" under the Magnuson-Stevens Act (MSA). This is a very important provision for the offshore aquaculture industry, as MSA provisions that restrict the size, season, harvesting methods, and other aspects relating to the possession of species managed under fishery management plans would render everyday aspects of aquaculture operations illegal. To safeguard wild fisheries, the Secretary is required to ensure, to the extent practicable, that offshore aquaculture does not interfere with MSA conservation and management measures for wild stocks and to consult with the appropriate Fishery Management Councils before issuing a permit under this Act. To facilitate enforcement, the Secretary is also given authority to require permit holders to track, mark, or otherwise identify fish or other marine species from the marine aquaculture facility so as to distinguish them from wild stock.

It should be noted that NOAA has always understood aquaculture to constitute "fishing" for both domestic and international law purposes. It is, therefore, necessary specifically to exclude aquaculture from MSA coverage.

Section 4(f) - Fees and Other Payments

Fees – Section 4(f) authorizes the Secretary to establish a schedule of application and annual permit fees.

Bonds – Section 4(f) requires the applicant to post a bond or other form of financial guarantee in a sufficient amount (to be established by the Secretary) to cover unpaid fees, the cost of removing a facility, and any other financial risks identified by the Secretary. This requirement reduces the financial risk to the Government of allowing aquaculture development in the EEZ, and provides a vehicle by which the Secretary can set bond requirements commensurate with the risk associated with specific aquaculture operations.

Right to waive fees – Section 4(f) allows the Secretary to waive fees for research facilities, or for facilities raising stock for purposes of stock enhancement. This provision acknowledges that the fee structure may discourage certain aquaculture operations or investments that are in the national interest. Offshore aquaculture is a new industry with significant start-up costs and most new businesses in all types of industries require at least several years of operation before they realize a profit.

Deposit of fees – All fees collected under the authority of this section must be deposited in the Treasury in accordance with the existing miscellaneous receipts statute.

Section 4(g) – Authority to Modify or Suspend Permits

Section 4(g) grants the Secretary authority to modify or suspend permits issued under the Act if the modification or suspension is found to be in the national interest, after consulting with other agencies as appropriate and giving the permit holder notice and an opportunity to respond. However, if the Secretary determines immediate suspension or modification is necessary, an emergency order may be issued if there are risks to human safety, the marine environment or marine resources, or the security of the United States. In the case of an emergency order, the permit holder would have an opportunity to be heard after the emergency modification or suspension.

Section 4(h) –Actions Affecting the Outer Continental Shelf

Section 4(h) gives the Secretary of the Interior authority with respect to aquaculture projects and operations located on facilities subject to the OCSLA. This includes the authority to enforce requirements contained in federal mineral leases and OCSLA regulations; require and enforce additional permit terms or conditions; issue emergency orders to permit holders; and promulgate any necessary rules and regulations to implement this section. The Department of the Interior needs this authority in order to meet its health, safety, and other responsibilities on facilities such as oil and gas platforms that may be used for offshore aquaculture. This section also includes provisions relating to agreements between aquaculture and OCSLA operators.

Section 4(i) – Transferability of Permits

The Secretary is authorized to establish a process for transferring permits from the original permit holder to another person meeting the eligibility requirements and able to satisfy the requirements for bonds or other guarantees.

SECTION 5. ENVIRONMENTAL REQUIREMENTS

Section 5 contains provisions for the establishment of environmental requirements and the monitoring and evaluation of compliance with permit conditions.

These provisions are important not only to environmental nongovernmental organizations (NGOs) and other stakeholders concerned about the potential negative impacts of aquaculture, but also to the aquaculture industry, since they will establish expectations for the aquaculture operations and provide a scientific basis for measuring compliance.

Section 5(a) – Environmental Requirements

Section 5(a) requires the Secretary to consult as appropriate with other federal agencies to identify environmental requirements under existing laws that are applicable to offshore aquaculture. Although not specifically named, these agencies would include the Environmental Protection Agency, the U.S. Army Corps of Engineers, and others. If necessary, additional requirements may be established by the Secretary of Commerce in consultation with appropriate federal agencies, coastal States and the public. Environmental requirements may include environmental monitoring, data archiving, and reporting. In setting environmental requirements, the Secretary is required to consider risks to and impacts on a range of concerns to be identified in consultation with other federal agencies. These include natural fish stocks, marine ecosystems, biological, chemical, and physical features of water quality and habitat, marine

mammals, other forms of marine life, birds, endangered species, and other features of the environment.

This provision preserves the roles and responsibilities of other federal agencies in establishing environmental requirements under current law (e.g., the Clean Water Act), while giving the Secretary of Commerce authority to impose additional requirements specifically relating to offshore aquaculture activities for which permits are issued under this Act. The intent is to avoid duplicative and/or conflicting requirements, allow the Secretary to fill in any gaps or deficiencies in such environmental requirements, and facilitate the identification of all requirements that apply to an offshore aquaculture operation regardless of which federal agency has primary responsibility.

Section 5(b) – Siting, Monitoring and Evaluation

Section 5(b) authorizes the Secretary to collect information to evaluate the suitability of sites for offshore aquaculture, and to promulgate regulations to facilitate monitoring and evaluation of compliance with permits (including the collection of biological, chemical, and physical oceanographic data as well as social, production, and economic data). This section also authorizes the Secretary to monitor the effects of aquaculture on marine ecosystems, implement measures to ensure compliance with environmental requirements, and establish monitoring and evaluation protocols. Remedial measures may include the temporary or permanent relocation of sites or a moratorium on additional sites within an area. The intent of this provision is to ensure monitoring of the cumulative impacts of all offshore aquaculture as well as the impacts of individual operations in the EEZ according to a common set of monitoring and evaluation protocols.

SECTION 6. RESEARCH AND DEVELOPMENT

Section 6(a) authorizes the Secretary of Commerce, in consultation with other federal agencies, to establish an integrated, multidisciplinary, scientific research and development program to further offshore aquaculture technologies compatible with the protection of marine ecosystems. Although not specified in the legislation, eligible areas of research would include scientific, social, legal, and environmental management issues.

Section 6(b) authorizes the Secretary to conduct research and development in partnership with site permit holders.

This section preserves the roles and responsibilities of other federal agencies with respect to aquaculture, as well as acknowledging the need to cooperate with industry for purposes of data collection as well as research and development.

SECTION 7. ADMINISTRATION

Sections 7(a) and 7(b) require the Secretary to promulgate, prescribe, and amend rules and regulations to carry out this Act, including authorization to protect offshore aquaculture facilities and, where appropriate, to request the Coast Guard to establish navigational safety zones. Section 7(b) also includes language specifying the authority of the Coast Guard to establish such zones.

Section 7(c) requires the Secretary to consult as appropriate with other federal agencies that are authorized to issue permits within the EEZ to promulgate regulations to establish and implement a coordinated and streamlined permitting process. This section requires that the process factor in the needs, requirements, and authorities of other federal agencies, including the need for consultation with State agencies and for public review and involvement. Although not specifically named, relevant agencies would include the Environmental Protection Agency, Minerals Management Service, the Army Corps of Engineers, and others.

Section 7(d) specifically authorizes the Secretary to establish agreements with other agencies (i.e., memoranda of understanding, memoranda of agreement, etc.) to implement this Act. It also authorizes the Secretary and other agencies to issue regulations to ensure coordination of federal activities to implement this Act.

Section 7(e) authorizes the Secretary to enter into agreements with other federal agencies and with State agencies relating to the use of personnel, services, equipment, and facilities, with or without reimbursement, for purposes of this Act.

Section 7(f) specifies that this Act is not intended to preempt the jurisdiction, responsibility or rights of other federal agencies, State agencies, or Indian tribes or Alaska Native organizations under any federal law or treaty. The intent of this provision is to eliminate the need to reference each and every statute or treaty that applies in the EEZ by stating that this Act will not preempt any existing authorities.

Sections 7(g) and 7(h) provide extraterritorial jurisdiction to protect offshore aquaculture facilities under U.S. law. It is not intended to supersede this Act or any other federal laws and regulations that apply in the EEZ - e.g., the Clean Water Act. Specifically, this section does not extend States' Clean Water Act jurisdiction beyond their current boundaries.

SECTION 8. AUTHORIZATION OF APPROPRIATIONS

Section 8 authorizes to be appropriated to the Department of Commerce "such sums as may be necessary for purposes of carrying out the provisions of this Act." Implementation of the Act will require funding to cover the costs of developing and implementing a regulatory and administrative system for offshore aquaculture, supporting internal and external R&D, developing environmental requirements, and monitoring, compliance, and enforcement.

SECTION 9. UNLAWFUL ACTIVITIES

Section 9 outlines activities that are unlawful under the Act. Unlawful activities include, but are not limited to, falsification of information; engaging in offshore aquaculture except in full compliance with this Act; obstruction of lawful enforcement activities such as search or inspection; interference with lawful search or inspection by an enforcement officer; resisting or interfering with an arrest; or violation of any provisions, regulations, or permits under this Act.

SECTION 10. ENFORCEMENT PROVISIONS

Section 10 grants enforcement authority under the Act to the Secretary of Commerce and the Secretary of the Department in which the Coast Guard is operating, and authorizes agreements for the use of personnel, services, equipment and facilities of other federal and State agencies in

enforcing this Act. It is not intended to be used to extend arrest powers to additional personnel or components. Section 10 also grants exclusive jurisdiction over cases arising under the Act to U.S. district courts, specifies the powers of enforcement officers, provides for the issuance of citations (that is, written warnings), holds violators subject to certain costs associated with the storage, care, and maintenance of seized property, and includes an injunctive relief provision.

SECTION 11. CIVIL ENFORCEMENT AND PERMIT SANCTIONS

Section 11 provides for both civil administrative and civil judicial penalties. Section 11 also grants the Secretary the authority to revoke, suspend, deny, and impose additional conditions or restrictions on a permit holder found to be committing or to have committed an unlawful activity under the Act. This section also contains provisions relating to hearings, judicial review, and the collection of civil penalties. Civil administrative penalties assessed by the Secretary may not exceed $120,000 per violation, with each day of a continuing violation considered a separate offense. Civil judicial penalties may not exceed $240,000 per violation, with each day of a continuing violation considered a separate offense.

SECTION 12. CRIMINAL OFFENSES

Section 12 identifies criminal offenses and associated maximum fines and prison terms, specifies violations that are Class C felonies, and establishes federal jurisdiction over these offenses.

SECTION 13. FORFEITURES

Section 13 provides for the forfeiture of property seized in the enforcement of this Act, and specifies the jurisdiction with respect to such forfeitures as any district court of the United States. The section includes provisions on judgments and procedures, and a rebuttable presumption.

Summary of Important Events Leading to the National Offshore Aquaculture Act of 2005

1878. The U.S. Commissioner of Fish and Fisheries begins an artificial propagation program in response to decreased marine fish landings off the Atlantic coast. Sport fishermen advocate for hatchery operations for freshwater fish.

1939. The U.S. Fish and Wildlife Service in the Department of the Interior assumes responsibility for artificial propagation programs for commercial and sport fisheries.

1966. Congress passes the National Sea Grant College Program Act, recognizing that aquaculture can substantially benefit the United States and setting in motion Sea Grant College Program activities to teach, conduct research, and provide extension services on a range of topics, including aquaculture.

1968. The Stratton Commission report recognizes marine aquaculture as a coastal use that should be included in a national ocean policy.

1970. Executive Reorganization Plan No. 4 creates the National Oceanic and Atmospheric Administration (NOAA). As part of the reorganization, all marine fishery programs are transferred from the Department of the Interior to the Department of Commerce, and the Bureau of Commercial Fisheries is reorganized into NOAA's National Marine Fisheries Service.

1978. The National Research Council (NRC) issues a report, "*Aquaculture in the United States: Constraints and Opportunities.*" In the report, the NRC observes that "constraints on orderly development of aquaculture tend to be political and administrative, rather than scientific and technological."

1980. Congress passes the National Aquaculture Act, stating that aquaculture is in the national interest. The Act establishes the interagency Joint Subcommittee on Aquaculture and instructs Federal agencies to conduct studies and report on "regulatory restrictions" to aquaculture development (Section 9(a)); prepare and submit to Congress a Regulatory Constraints Study with steps to remove unnecessarily burdensome regulatory barriers to the initiation and operation of commercial aquaculture ventures (Section 9(b)); and develop a National Aquaculture Development Plan to identify aquatic species with significant potential for culturing on a commercial or other basis (e.g., stock enhancement) and to recommend actions to be taken by public and private sectors to achieve that potential.

1983. The first National Aquaculture Development Plan is completed by the Joint Subcommittee on Aquaculture, providing the first comprehensive federal identification of priorities in U.S. aquaculture.

1992. A second National Research Council Report, *"Marine Aquaculture: Opportunities for Growth"* calls for "a framework…..to provide an orderly process for the leasing and conduct of marine aquaculture operations to reduce the uncertainty that industry now faces…."

1993-1994. Five legislative bills dealing with aquaculture are introduced in the 103rd Congress, but none are enacted.

1995. A bill (S.1192) is introduced to strengthen the Commerce Department's marine aquaculture responsibilities, but it is not reported out of the Senate Commerce Committee.

1996. A revised National Aquaculture Development Plan identifies regulatory problems and focuses on solutions:

> "*4.4.8 Federal Regulatory Framework*.
>
> *Challenges*. The complex, fragmented, and uncertain regulatory environment affecting aquaculture is a deterrent to the development of a profitable and competitive U.S. aquaculture industry. Because aquaculture involves land and water use as well as the production, processing, and distribution of food for human consumption, a number of Federal, State, and local government agencies are involved in regulating the industry. As a result, aquatic farmers may either be required to comply with a daunting and expensive array of regulations or, as exemplified by offshore marine aquaculture initiatives, be forced to operate in a highly uncertain regulatory framework.
>
> *Opportunities*. The Federal government has a responsibility and opportunity to develop alternative, rational approaches to the Federal permitting, licensing, and regulatory requirements now in place. This can include clarification, streamlining, and consolidation, wherever possible, of the regulatory process, while simultaneously ensuring protection of the health and well-being of the population and environment.

5.8 Federal Regulatory Framework. The Federal government will:

5.8.1 Recommend Improvements to the Federal Regulatory Framework: Review and recommend improvements to the Federal regulatory framework for discharge regulations, permits, and monitoring; fish health inspection; transport and export of live aquaculture products; depredation control; research on and commercial culture of genetically altered aquatic organisms; seafood inspection and safety; cultivation of "non-indigenous" species; testing and approvals of new animal drugs and vaccines; *permits and regulations for commercial aquaculture operations in public waters, including Federal marine waters* (emphasis added); and other issues as appropriate.

5.8.2 Implement Recommendations to Improve Regulatory Framework: With direct cabinet-level leadership, evaluate and implement recommendations to improve the Federal regulatory framework for aquaculture.

5.8.3 Evaluate Discharge Standards and Discharge Impacts: Support efforts to evaluate existing water quality standards for discharge from aquaculture facilities and the impact of other discharges on aquaculture operations.

5.8.4 Develop Improved Compliance Standards for Public Waters: Develop simplified and uniform standards for review procedures, uniform siting standards, baseline surveys, monitoring protocols, and reporting requirements for aquaculture in public waters.

1997. NOAA completes the first draft of offshore aquaculture legislation as part of a broader effort among federal agencies to address gaps in statutory authorities with respect to aquaculture. The NOAA bill specifically addresses the regulatory gap that had become evident in the Federal Exclusive Economic Zone (EEZ).

1998. The NOAA Aquaculture Policy is adopted. The policy recognizes the need to deal with emerging issues and encourages marine aquaculture to develop in an environmentally responsible manner.

1998-1999. NOAA distributes the first draft of the offshore aquaculture legislation to constituents at national aquaculture conferences.

1999. The Department of Commerce Aquaculture Policy is adopted. The policy set targets for increasing U.S. aquaculture production and jobs. Like the NOAA policy, the DOC policy emphasizes sustainable aquaculture development.

1999. NOAA begins a 5-year Marine Aquaculture Initiative funding numerous projects in areas identified in consultation with the Joint Subcommittee on Aquaculture and NOAA constituents. Top priorities include research in regulatory reform, siting of facilities, environmental standards, regional cooperation, and demonstration projects for offshore (also known as open ocean) aquaculture.

2000. NOAA submits a draft National Offshore Aquaculture Act to the Office of Management and Budget (OMB) for Federal interagency review. Clearance process is interrupted by a change in Administrations in January 2001.

2003. NOAA shares a revised version of offshore aquaculture legislation for discussion with other federal agencies on the Joint Subcommittee on Aquaculture.

2003. The PEW Oceans Commission report recommends that "Congress should require the development of a comprehensive and environmentally oriented permitting system for offshore aquaculture".

2004. NOAA submits the National Offshore Aquaculture Act to OMB for interagency clearance.

2004. The U.S. Commission on Ocean Policy makes four recommendations regarding marine aquaculture, one of which is for NOAA to be responsible for developing a comprehensive, environmentally-sound permitting, leasing, and regulatory program for marine aquaculture.

2004. The Bush Administration responds to the U.S. Commission on Ocean Policy by issuing the U.S. Ocean Action Plan, which includes a commitment to submit national offshore aquaculture legislation to the 109th Congress.

2005. In June, the Administration clears the National Offshore Aquaculture Act of 2005 and transmits the proposed legislation to Congress for action.

FINAL REPORT

An Ocean Blueprint

for the 21st Century

U.S. Commission on Ocean Policy

CHAPTER 22

Setting a Course for Sustainable Marine Aquaculture

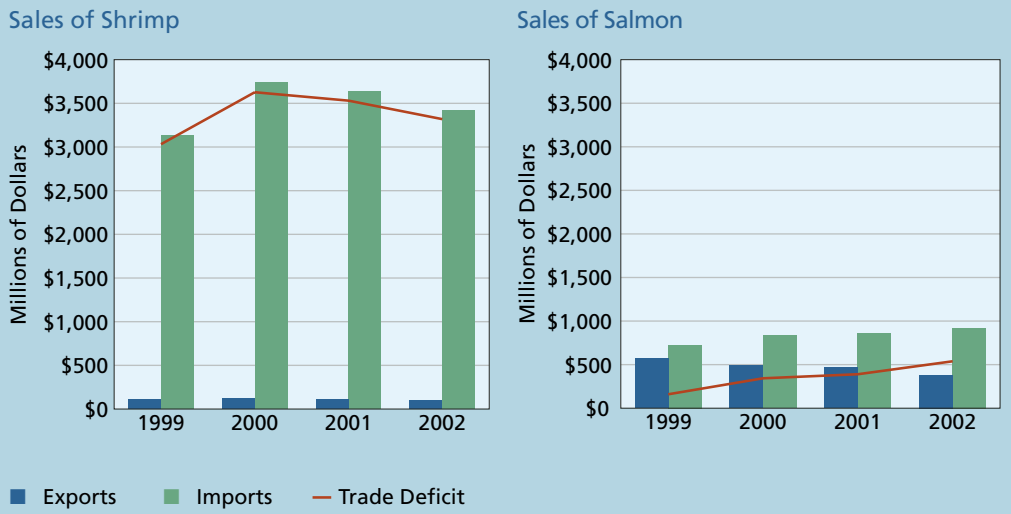
As world consumption of seafood continues to increase, the farming of marine species has become a rapidly growing domestic and international industry. There are, however, a number of challenges that this industry presents. Nearshore marine aquaculture activities are affected by increasing population and development pressures and confusing or overlapping laws, regulations, and jurisdictions. Aquaculture operations in offshore waters lack a clear regulatory regime, and questions about exclusive access have created an environment of uncertainty that is detrimental to investment in this industry. Also of concern are potential threats to the environment and to native fish populations, and conflicts between aquaculture and other uses of the nation's ocean and coastal waters. A lead federal agency with an office dedicated to marine aquaculture is needed to address jurisdictional issues and to ensure the development of an economically and environmentally sound marine aquaculture industry.

Acknowledging the Growing Significance of Marine Aquaculture

As traditional harvest fisheries have approached and exceeded sustainable levels, the farming of fish, shellfish, and aquatic plants in marine and fresh waters has become a burgeoning global industry. These organisms can be raised in everything from nearly natural environments to enclosed structures, such as ponds, cages, and tanks, where they are fed and treated to maximize their growth rate.

In the United States, the demand for seafood continues to grow as expanding numbers of Americans seek healthier diets. During the 1980s and 1990s, the value of U.S. aquaculture production rose by about 400 percent, to almost $1 billion. This figure includes fresh-water and marine finfish and shellfish, baitfish, and ornamental fish for sale to aquariums.[1] Along with fish farmers themselves, the aquaculture industry supports an infrastructure of feed mills, processing plants, and equipment manufacturers. There is great potential for marine aquaculture to become an even more important source of seafood for the U.S. market and a way to help reduce the nation's seafood trade deficit of $7 billion a year (Figure 22.1).[2]

Figure 22.1 The United States Imports More Seafood Than It Exports



The values of U.S. imports and exports for both shrimp and salmon illustrate the trade deficits caused by the nation's inability to harvest or culture enough seafood to meet consumer demand.

Source: U.S. Department of Agriculture, Economic Research Service. *Aquaculture Outlook 2003.* LDP-AQS-17. Washington, DC, March 14, 2003.

Addressing Environmental Impacts of Aquaculture

National management of marine aquaculture activities should minimize potential environmental impacts. These impacts include the spread of disease among fish populations, genetic contamination and competition between farmed and native stocks, and effects from aquaculture operations on water quality, wetlands, and other natural habitats. Fish waste, dead fish, uneaten food, and antibiotics may contaminate the water around aquaculture facilities and harm surrounding ecosystems. Marine mammals, attracted by the food source, can become entangled in nets. There are also concerns about the increased demand for fishmeal used to feed farm-raised carnivorous fish. Obtaining fishmeal from traditional wild harvest practices may increase the pressure on fisheries that are already fully exploited. Extensive research is underway by the aquaculture community to determine how to decrease this demand.

Another issue of increasing concern is the possible introduction of non-native species (intentionally or unintentionally) through marine aquaculture operations. In the United States, many cultured marine species are not native to the area where they are being farmed. In these cases, there is the possibility that foreign (or genetically-modified) animals or their reproductive offspring may escape and potentially compete or reproduce with wild populations, resulting in unpredictable changes to ecological, biological, and behavioral characteristics. Where non-native species come in contact with already depleted fish or shellfish stocks, recovery efforts may be hampered.

Potential problems associated with the introduction of non-native species are illustrated in the case of the Atlantic salmon, which is one of the most widely farmed fish species in the United States and around the world. Escaped farm-bred salmon, which differ genetically from species of wild Atlantic salmon, have the potential to both compete with native salmon species (at least one of which has been listed as threatened or endangered under the Endangered Species Act) for limited resources, interbreed with native species causing changes in the gene pool, and spread disease. Infectious salmon anemia and sea lice,

which are widespread in European salmon aquaculture facilities, have recently appeared in North American operations.[3]

Another example, discussed in more detail in Chapter 17, is the proposed farming of a non-native oyster species from China in Chesapeake Bay tributaries. This Chinese oyster appears to be resistant to the diseases plaguing native species. However, a 2003 National Research Council report raised serious questions about the possible ramifications of such an introduction.[4] It is now up to state officials to decide what is best for the Bay, in both the short- and long-term, with little science or law to guide them.[5] Ironically, the steep decline in the Bay's native oyster population was caused in part by a disease introduced in the 1950s during a previous attempt to establish a non-native oyster species.

All of the potential impacts discussed in this section need to be addressed if the nation is to achieve an environmentally and economically sustainable marine aquaculture industry.

Dealing with Uncertainties in the Existing Management Structure

The potential contribution of marine aquaculture to the nation's economic growth and to meeting the increasing demand for seafood is impeded by its current management framework, which is characterized by complex, inconsistent, and overlapping policy and regulatory regimes administered by numerous state and federal agencies.

Because nearly all marine aquaculture activities operating today are located in nearshore waters under state jurisdiction, the majority of laws and regulations that authorize, permit, or control these activities are found at the state level and are not designed to address offshore aquaculture activities in federal waters. For example, one of the first U.S. commercial open ocean aquaculture projects in Hawaii began in 2001 with the lease of 28 acres of state marine waters to a private company, following a 1999 state legislative authorization to allow commercial offshore aquaculture leasing. Other nearshore aquaculture activities—most of which are in the pilot project stage—include the operation of a federally-sponsored experiment off the coast of New Hampshire and a salmon facility off of Maine.

Marine Aquaculture in Offshore Areas

As competition for space in nearshore areas intensifies, the marine aquaculture industry is looking increasingly toward opportunities in federal offshore waters. The expansion of aquaculture activities into the outer Continental Shelf provides potential benefits, as well as additional concerns. Locating marine aquaculture activities farther offshore may reduce the visibility of these activities from land, be less intrusive to fisheries and recreational activities, and have fewer environmental impacts than activities located in nearshore areas. However, the logistics associated with operating offshore facilities are also more difficult, requiring long transit times for workers and supplies, and other technical complications. Offshore aquaculture structures must also be designed to withstand the effects of extreme winds, waves, and temperatures, and be positioned in a way that does not create a hazard to navigation.

The Current Regulatory Conundrum

There are numerous federal agencies directly or indirectly involved in implementing laws associated with various aspects of offshore activities, including marine aquaculture. These include the U.S. Departments of Agriculture and the Interior (USDA and DOI), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Food and Drug

Administration, the U.S. Army Corps of Engineers (USACE), the U.S. Coast Guard, and the U.S. Environmental Protection Agency (EPA). The responsibilities of these agencies range from protecting water quality and other environmental resources, to navigation, food safety concerns, and interactions with federal fishery management plans. The jumble of authorities makes it difficult for those involved in aquaculture activities to know what permits are needed and what relevant rules govern their operations. (See Box 6.1 Swimming Through Hoops: Establishing an Offshore Aquaculture Facility.) Simply put, there is no overall ocean governance structure to comprehensively manage this new and emerging use in federal waters.

In 1980, Congress passed the National Aquaculture Act, stating that it is in the national interest to encourage the development of aquaculture in the United States and calling for a national aquaculture development plan. The Act required the Secretaries of Agriculture, Commerce, and the Interior to prepare a report on federal laws and regulations that restrict the development of commercial aquaculture operations and submit the report to Congress with recommendations on how to remove unnecessarily burdensome regulatory barriers. However, no streamlined regulatory regime has been developed.

As a result of this mix of laws and regulations, applicants have no guarantee of exclusive use of space in offshore areas, private capital is difficult to obtain, insurance companies do not provide coverage, and banks are unwilling to accept the unknown risks involved. Enhanced predictability is needed, as is the elimination of unnecessary hurdles and the reduction of potential conflicts with other commercial and recreational users of offshore areas and resources.

Developing a New Marine Aquaculture Management Framework

For the marine aquaculture industry to reach its full potential, the United States, in cooperation with states, tribes, and territories, should develop a coordinated and consistent policy, and a robust regulatory and management framework. Federal and state agencies, with full participation by the industry, will need to implement the new framework, and the academic community will be called upon to provide scientific and engineering support to ensure that marine aquaculture activities are ecologically and economically sustainable. It is important for this framework to be flexible and responsive to changes in the industry. Finally, as noted, development of a national aquaculture management framework must be considered within the context of overall ocean policy development, taking into account other traditional, existing, and proposed uses of the nation's ocean resources. (More information about developing a framework for managing multiple activities in federal waters, including aquaculture, is found in Chapter 6.)

The US aquaculture industry is developing in an unprecedented environmental and food safety climate. In many respects, this helps ensure the aquaculture industry is environmentally sustainable, while still providing needed rural employment and income.

—Dr. Robert Rheault, *Board Member, National Aquaculture Association, testimony to the Commission, June 2002*

Coordinated Action

The inherent differences between land-based, closed-system aquaculture operations and marine-based operations should be acknowledged in any new legislation and in the new management framework. The respective roles of the federal agencies involved with the marine aquaculture industry must also be clarified, duplicative or outdated laws and regulations eliminated, and marine aquaculture policies, programs, and practices coordinated. In addition, a lead federal agency is needed to act as the main interface with industry and overseer of the government's public trust responsibilities.

The National Aquaculture Act of 1980 established the Joint Subcommittee on Aquaculture (JSA) within the National Science and Technology Council (NSTC) structure. The JSA coordinates federal agency activities, ensures communication among the agen-

cies, and provides recommendations for national aquaculture policy. Members of the JSA include: the Secretaries of USDA (permanent chair), DOI, the Departments of Commerce, Energy, and Health and Human Services; the Administrators of EPA, the Small Business Administration and the U.S. Agency for International Development; the Chair of the Tennessee Valley Authority; and the Director of the National Science Foundation. This kind of coordination is necessary, although the issues to be addressed go far beyond the purview of the NSTC. Close coordination will be needed between the JSA and the National Ocean Council.

Recommendation 22–1

Congress should amend the National Aquaculture Act to designate the National Oceanic and Atmospheric Administration (NOAA) as the lead federal agency for marine aquaculture, create an Office of Sustainable Marine Aquaculture in NOAA, and designate the Secretary of Commerce as a permanent co-chair, along with the Secretary of Agriculture, of the Joint Subcommittee on Aquaculture. NOAA should use this authority to design and implement national policies for environmentally and economically sustainable marine aquaculture.

Implementation

In overseeing marine aquaculture activities, including evaluating and approving offshore aquaculture operations, NOAA will need to practice wise stewardship of ocean resources and weigh the needs of a variety of stakeholders. At the same time, offshore aquaculture operators will need assurance that they can have exclusive access to certain waters for specific periods of time to secure financial investments.

These goals can best be achieved through the development and implementation of a leasing system for the ocean surface, water column, and ocean bottom that protects marine resources and environments, offers adequate exclusivity to aquaculture operations, and institutes a system of revenue collection that acknowledges the public interest in ocean space and resources. The leasing system will also need to specify details, such as applicant eligibility and the acceptable scope, size, duration, and degree of exclusivity for facilities. Competing uses of ocean and coastal areas, and the potential for impacts from aquaculture on other ocean uses, must also be considered.

Enhanced coordination is also needed between federal and state aquaculture policies and regulations to provide consistency to the industry and to adequately manage potential impacts that cross jurisdictional lines, such as the spread of disease. Significant state participation and input is needed in the development and implementation of a new national management framework, which should include guidelines and regulations that are complementary at the federal and state levels. The interstate fishery commissions could be a valuable resource to assist in coordinating federal and state activities.

Recommendation 22–2

The National Oceanic and Atmospheric Administration's new Office of Sustainable Marine Aquaculture should be responsible for developing a comprehensive, environmentally-sound permitting, leasing, and regulatory program for marine aquaculture.

The permitting and leasing system and implementing regulations should:

- reflect a balance between economic and environmental objectives consistent with national and regional goals.
- be coordinated with guidelines and regulations developed at the state level.
- include a system for the assessment and collection of a reasonable portion of the resource rent generated from marine aquaculture projects that rely on ocean resources held in the public trust.

- include the development of a single, multi-agency permit application for proposed marine aquaculture operations.
- include a permit review process that includes public notice and an opportunity for state, local, and public comment.
- require applicants to post a bond or other financial guarantee to ensure that any later performance problems can be remedied and that abandoned facilities can be safely removed at no additional cost to taxpayers.
- require the development, dissemination, and adoption of best management practices, with periodic updates to reflect advances in research and technology.
- be well coordinated with other activities in federal waters.

NOAA Photo Library

The SeaStation 3000 is an experimental aquaculture facility off the coast of Hawaii. The sea cage lies 40 feet below the surface to reduce the risk of harm to the cage or the fish from large ocean swells and is out of the way of local boating traffic. The project is the first of its kind in Hawaii and may serve as a model for future offshore aquaculture.

Increasing the Knowledge Base

Enhanced investments in research, demonstration projects, and technical assistance can further the development of a responsible and sustainable marine aquaculture industry. Science-based information can help the industry address environmental issues, understand socioeconomic impacts to coastal communities, conduct risk assessments, develop technology, select species, and improve best management practices. It is also vital for developing fair and reasonable policies, regulations, and management measures.

In the last two decades, the number of research and monitoring programs related to aquaculture has surged. Much of the work conducted worldwide has focused on the effects of open-water, net-pen culture on the environment. In the United States, early research efforts focused on fish hatchery effluents and catfish ponds. As the domestic industry has diversified, so has the scope of research efforts. Major federal investments are examining the impacts of marine shrimp-pond and salmon net-pen cultures, as well as issues concerning aquaculture feeds, species introductions, the use of chemicals and pharmaceuticals, and effluent controls.

Most of the federal research to support marine aquaculture has been carried out under the auspices of NOAA's National Sea Grant College Program, which funds primarily university-based research. Results are used by educators and outreach specialists to improve resource management and address development and conservation issues. Sea Grant-funded information is also used to increase the knowledge base of industry, government agencies, and the public. As noted in Chapter 25, research on the potential socioeconomic impacts of marine aquaculture is sparse.

Recommendation 22–3

The National Oceanic and Atmospheric Administration's new Office of Sustainable Marine Aquaculture should expand marine aquaculture research, development, training, extension, and technology transfer, including a socioeconomic component. The Office should set priorities for research and technology, in close collaboration with the National Sea Grant College Program, states, tribes, academia, industry, and other stakeholders.

Promoting International Improvements and Cooperation

An estimated one billion people worldwide rely on fish as their primary source of animal protein. This demand will continue to rise as human populations increase and wild stocks around the world are depleted. Aquaculture has been growing almost six times faster in developing countries than in developed countries. The United Nations Food and Agriculture Organization (FAO) estimates that by 2030 more than half of the fish consumed globally will be produced through aquaculture.[6]

While the majority of international aquaculture occurs in inland and coastal areas, interest in offshore operations is also growing. There are even proposals to establish aquaculture operations on the high seas (see Chapter 29 for a discussion of emerging international ocean-related management challenges). This new interest is accompanied by growing concerns about the potential environmental impacts of offshore operations. The use of non-native species for aquaculture also poses ecological risks, particularly in view of the absence of regulations and enforcement in many countries. Global policies on prevention, containment, monitoring, and risk assessments are needed to prevent the spread of invasive species and ensure that industries operate sustainably.

Efforts are underway at FAO to assess the possible environmental implications of growing aquaculture operations around the world and to develop appropriate protocols for use by government and industry. In the meantime, FAO's non-binding Code of Conduct for Responsible Fisheries includes a number of aquaculture provisions. The Code calls for: appropriate assessments and monitoring to minimize adverse impacts from discharges of effluents, waste, drugs, and chemicals; consultation with neighboring countries prior to the introduction of non-native species; conservation of genetic diversity; and responsible choices of species, siting, and management. The implementation of these guidelines will require strong commitments from the global community.

Recommendation 22–4

The United States should work with the United Nations Food and Agriculture Organization to encourage and facilitate worldwide adherence to the aquaculture provisions of the Code of Conduct for Responsible Fisheries.

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U.S. Ocean Action Plan

The Bush Administration's
Response to the U.S. Commission on Ocean Policy

responsibilities in fisheries management and enforcement, these strategies complement each other and, when used together, form the National Strategy for Fisheries Enforcement.

Advance Offshore Aquaculture

The United States imports a large amount of seafood from other nations and currently suffers a seafood trade deficit of $7 billion annually. The U.S. offshore aquaculture industry is attempting to establish aquaculture facilities in the U.S. Exclusive Economic Zone (EEZ) but faces a confounding array of regulatory and legal obstacles. The Administration has taken the following actions to support the development of environmentally sound aquaculture in the EEZ and internationally.

- Propose National Offshore Aquaculture Legislation. In the 109th Congress, the Administration will propose a National Offshore Aquaculture Act that provides the Department of Commerce clear authority to regulate offshore aquaculture. This bill will empower the Department of Commerce to assist the private sector in obtaining necessary Federal agency approval for establishing an offshore aquaculture facility. The Department of Commerce has primary responsibility for the management and conservation of living marine resources in the EEZ and, as such, will ensure that offshore aquaculture enterprises operate in an environmentally sustainable manner that is compatible with existing uses.

- Established Aquaculture Effluent Guidelines. EPA has authority under the Clean Water Act to regulate pollutant discharges to waters of the United States. This authority applies to concentrated aquaculture facilities, including marine aquaculture, and is administered under the National Pollutant Discharge Elimination System Program. Under this authority, EPA recently issued guidelines for discharges from aquaculture facilities to help protect water quality.

- Support Aquaculture in the Americas. In 2005, working with Asia Pacific Economic Cooperation (APEC) partners, the Administration will support two workshops in South America to promote sustainable aquaculture and the development of an aquaculture network in the Americas.

Improve Marine Managed Areas

- Coordinate and Better Integrate the Existing Network of Marine Managed Areas. National Parks, National Wildlife Refuges, National Marine Sanctuaries, and National Estuarine Research Reserves conserve a rich assemblage of coral reefs, estuaries, wetlands, kelp forests and beaches. These parks, refuges, sanctuaries, and estuarine reserves were established under separate legal authorities and are separately managed by the Department of the Interior (parks and refuges) and the Department of Commerce (marine sanctuaries) or are cooperatively managed by the Department of Commerce and States (estuarine reserves). Many National Marine Sanctuaries, National Parks, National Wildlife Refuges and National Estuarine Research Reserves around the nation overlap, adjoin or lie near each other at various sites. The Administration proposes to further integrate the management of existing parks, refuges, sanctuaries, and estuarine reserves in marine and coastal areas. These actions, where appropriate, will complement actions under Executive Order 13158, regarding Marine Protected Areas. Taking steps to integrate the existing marine managed areas network represents a new way to promote coordination of research, public education and management activities at neighboring parks, refuges, sanctuaries, and estuarine

Fish Farming FAQs

cinemar

Marine aquaculture, in particular finfish farming, is a relatively new industry for the United States. Stimulated by the recognition that capture fisheries could not meet the growing demand for seafood, salmon farms were established in U.S. coastal waters, primarily in the Gulf of Maine and the Pacific Northwest. During the industry's incubation period, justifiable concerns over the impact of these farms on the surrounding ecosystems arose. Since then, advances in engineering, fish husbandry, and site location have significantly reduced its environmental impact. What is the outlook for the future? Compiled by the Open Ocean Aquaculture Project at the University of New Hampshire, this sheet looks at common assumptions about marine aquaculture today, and its prospects for moving to the open ocean.

What is marine aquaculture?

Also referred to as "mariculture," marine aquaculture is the farming of food products in ocean waters. Popular commercial crops in the United States include clams, mussels, seaweeds, shrimp, and salmon. Much of this activity takes place in nearshore coastal waters. With such waters already crowded with other activities, research initiatives like UNH's Open Ocean Aquaculture Project (OOA) in the Gulf of Maine are exploring the environmental and economic prospects of farming finfish and shellfish in the open ocean.

Does finfish farming impact the ocean bottom?

Early fish farms were sited in protected bays and coves for operational convenience and to protect cages from weather and currents. In shallow water sites with less circulation, excess fish feed and waste sometimes built up on the ocean floor, creating an oxygen-poor environment in which many bottom-dwelling species could not survive.

To reduce waste buildup, most farmers have adopted management practices that involve strategic site selection criteria, improved feed formulation, optimum stocking densities, feed loss monitoring, a better understanding of currents and tides, and cage site rotation.

In the open ocean, deep water and increased circulation reduce the likelihood of impact on the sea floor. A rigorous monitoring program has determined that UNH's OOA has had no measurable environmental impact in the Gulf of Maine.

Does shellfish culture impact the environment?

Shellfish feed by filtering plant cells from the surrounding water. As a result, shellfish farms actually improve water quality. Currently, OOA researchers are exploring the environmental benefits of integrating the farming of blue mussels and finfish such as cod. In such a system, mussels remove the excess carbon and nitrogen that comes from feeding fish.

Does marine aquaculture involve genetically modified fish?

Fish farmers have never raised genetically modified fish in U.S. coastal waters. The preferred method for broodstock development is selective breeding. Currently, all open ocean aquaculture projects in the U.S. involve species native to the region in which the project takes place. UNH's OOA raises blue mussels, cod, haddock, and halibut.

Do escaped fish threaten wild stocks?

Fish can escape from net pens damaged by storms, predators, or even the farmed fish themselves. Scientific perspectives on the impact of escaped fish on wild stocks vary. For this reason, and for cost-effectiveness, the industry has developed more durable equipment. Today's cages and anchoring systems are far more robust, and have dramatically reduced the number of escaped fish. In five years of farming in the harshest ocean conditions, UNH's OOA has not had one fish escape.

How many pounds of wild fish does it take to raise a pound of farmed fish?

In the wild, carnivorous fish such as salmon will consume roughly 10 pounds of fish to gain one pound of body weight. Farmed fish also consume wild fish—albeit as an ingredient in formulated feed. This feed is made from fish meal and oil, and vegetable-based fats, proteins, and carbohydrates. As a result, farmed fish consume only about three pounds of processed, wild fish for every pound they gain.

Most of the fish meal in feed comes from the anchovy fishery off the coast of South America. The annual capture of this fishery has remained stable since the 1960s, despite the rise in aquaculture. Approximately 30 percent of the world's fish meal production is used to feed fish; the remainder goes to pig and chicken feed.

The OOA's study of fish physiology and behavior with biotelemetry and video techniques is laying the foundation for more efficient feeding practices.

Are there health risks associated with eating farm-raised salmon?

Despite recent reports about the levels of PCBs in farmed salmon, it remains a heart healthy diet choice, according to the American Heart Association. The association holds that this advantage far outweighs the modest risks suggested by these reports. Levels of PCBs and other persistent environmental chemicals found in farmed salmon are significantly lower than FDA standards, and lower than levels found in many other popular foods such as dairy products, meat, and poultry.

Are antibiotics used in farmed fish?

Marine aquaculture has made tremendous progress in the use of probiotics and vaccinations before fish are stocked into cages. Over 10 years, antibiotic use has declined 97 percent, while production has increased 360 percent.

What is the outlook for the future?

Healthy oceans are vital to our physical and economic well-being. For aquaculture to succeed, it must be developed within the context of surrounding ecosystems. Projects that advance the industry's profitability must be consistent with efforts to restore and sustain the health, productivity, and biological diversity of the oceans.

Phase II of UNH's Open Ocean Aquaculture Project is being designed with this in mind. Its holistic approach will account for the safety of the people who manage the farms, the well-being of the crops, the integrity and efficiency of the structures and systems, the health of the surrounding environment, the consumers who rely on seafood products, and the dynamic relationships that weave all of these together.

We welcome your interest and questions:

http://ooa.unh.edu

The Open Ocean Aquaculture Project is part of the Cooperative Institute for New England Mariculture and Fisheries (CINEMAR), a partnership between the University of New Hampshire and the National Oceanic and Atmospheric Administration.

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